State of New Jersey
County of Monmouth

AFFIDAVIT

On this day, Suzanne F. Gagliardi personally appeared before me and after being duly sworn, deposes and states:

That she is certified by the American Translators Association in translation from German into English, that she is an Active Member in good standing of the American Translators Association; and that her member number is 2376;

That she has carefully made the attached German translation from the original document:

German Patent Application no. DE 199 51 382.1 filed on October 26, 1999 at the German Patent Office, entitled

„Bogentransportsystem für eine Rotationsdruckmaschine"

[Sheet Transport System for a Rotary Press]

written in German; and

That the attached translation is an accurate English version of such original to the best of her knowledge and belief.

Suzanne F. Gagliardi
SUZANNE F. GAGLIARDI

Subscribed and Sworn to before me this 13 day of OCT, 2004.

Notary Public
DOROTHY J. ANGUAD
NOTARY PUBLIC OF NEW JERSEY
My Commission Expires Sept 13, 2005

SHEET TRANSPORT SYSTEM FOR A ROTARY PRESS

Specification

The present invention relates to a sheet transport system for a rotary **[printing]** press having **[runner]** rails configured on both sides of a sheet transport path, driven grippers being guided on these rails for pulling a sheet to be conveyed in the feed direction.

From German DE 4 302 125 A1, a sheet transport system is known, where sheet grippers grip the side edges of a pre-printed **[factory-printed]** sheet at a rear sheet section, viewed in the feed direction. These lateral grippers are used in cooperation with grippers which are configured on a gripper bar and which hold the front sheet edge, viewed in the feed direction, to prevent the sheet from fluttering and, thus, from colliding with parts of the printing press, thereby avoiding any blurring of the ink freshly printed thereon. These lateral sheet grippers do not execute their own driving function. Rather, they exert a force on the sheet oppositely to the feed direction to ensure that the sheet is held tightly **[stretched tightly to keep it taut]**.

Since the intended use of the lateral sheet grippers of this known transport system is to protect factory-printed sheets, there is no reason to consider using them in a sheet transport system at any location other than behind the printing unit, viewed in the feed direction.

From the German DE-OS 2 501 963, one knows of another sheet transport system for a rotary press, having rails arranged on both sides of a sheet transport path. The rails have a cross bar mounted thereon, which **[in turn]** have grippers mounted thereon for gripping a front edge, viewed in the feed direction, of a sheet to be printed. With the aid of the gripper mounted thereon, this cross bar pulls a sheet to be printed through a gap **[nip]** between

a printing cylinder[1] and a blanket cylinder. On their peripheral surface, both cylinders have a channel-type segment, which is sized to accommodate the cross bar, including the grippers mounted thereon, as it moves through the gap.

In the case of this known transport system, precise synchronization of the motion of the cylinder and cross bar is extremely important. A synchronization error can cause the cross bar and cylinder to collide in a position of the cylinder where the cross bar is not able to mate or fully mate with the channels. The result is that the cross bar becomes jammed, which can lead to considerable damage to the cross bar and to the cylinders, and possibly to their mount fixtures and driving devices as well.

One cannot obviate the danger of such collisions safely enough simply by electronically synchronizing the motion of the transport system and of the cylinders. Satisfactory operational reliability can only be achieved by a mechanical forced coupling of the parts that dip into one another, for example with the aid of geared tension[2] and/or by using a mainshaft.

A further drawback of transporting sheets using a cross bar that dips into the gap between the blanket cylinder and the printing cylinder is that the rotation of the cylinders excites vibrations in the printing press. When ink is transferred onto a sheet to be printed, the blanket cylinder and printing cylinder are pressed against each other; when the channels mutually oppose each other, such pressing does not occur. The result is a dynamic excitation of vibrations in the printing press. Since the natural frequencies of printing presses are often near their maximum rotational speeds, it is precisely this intense vibrational excitation that limits any further increase in productivity.

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[1] **Translator's note: "Druckzylinder" can be translated as "printing cylinder" or as "impression cylinder" when plastics are involved.**

[2] **Translator's note: It may be that "Zahnradzug" is an actual mechanical component and not exactly "geared tension", as translated. I only found one instance of it in a parts list on a German Internet site.**

An additional consequence of this vibrational excitation is that the contact **[printing]** pressures between the printing cylinder and blanket cylinder are limited. This, in turn, limits the use of stamping dies, for example.

The object of the present invention is to provide a sheet transport system for a printing press that can be run with a high level of operational reliability, at high pressures and high speeds. This is achieved by a sheet transport system having rails which are arranged on both sides of a sheet transport path and in which driven grippers are guided for pulling a sheet to be transported in the feed direction, as known from German DE-OS 2 501 693, in that the grippers engage with side edges of the sheet near its front end, viewed in the feed direction. This measure completely eliminates the need for a cross bar and for grippers mounted thereon for pulling the sheet at its front edge. The result, of course, is that the danger of collision between the cross bar and the cylinders is eliminated.

At the same time, the channels on the blanket cylinders and printing cylinders can be completely eliminated or reduced to the extent that is essential for securing the blanket or the printing plate to these cylinders. In any case, reducing the channels lessens vibrational excitation, thereby permitting higher rotational speeds and enhancing productivity for the printing press.

A sheet transport system of this kind can run continuously between a feeder and a delivery device of the rotary press. The need is eliminated for transferring a sheet to be printed between various gripper devices while the sheet is fed through the press. Consequently, even print positioning errors resulting from errors when transferring the sheet among various gripper devices are ruled out.

Since there is no longer a danger of the grippers and cylinders of the printing press colliding, all that is needed to synchronize

the motion of the grippers with that of the cylinders is an electronic control circuit.

Since the cross bar for coupling grippers holding a same sheet is eliminated, the control circuit can also be effectively used to synchronize these grippers.

Another gripper pair can be run on the **[runner]** rails to grip a lagging sheet end. This gripper pair is preferably braked in order to keep the held sheet securely taut.

The grippers of the sheet transport system preferably each have two clamping jaws, magnets being configured at opposite ends of the rails, viewed in the feed direction, to open the clamping jaws by magnetic force, enabling them to clamp a sheet to be printed at a pick-up **[device]** and release it again at a delivery **[device]**. The clamping jaws can be squeezed together in simple fashion by a spring element.

To facilitate a simple pick-up and release of the sheets, it is expedient for the rails to diverge at their ends transversely to the feed direction, in the plane of the transported sheet.

Although the present invention relates to a sheet transport system for a rotary press and the practical embodiments in the following likewise concern a rotary press, the principle underlying the present invention that the grippers engage with side edges of the sheet near its front end, viewed in the feed direction, can also be applied to other processing machines used for flat products. These could include, in particular, all types of copying machines, such as printers based on the principle of toner printing.

Other features and advantages of the present invention are derived from the following description of exemplary embodiments, reference being made to the figures, which illustrate:

Figure 1 a substantially schematized section through a portion of a printing press having a sheet transport system in

accordance with the present invention;

Figure 2 a plan view of the transport system having a sheet guided between two grippers;

Figure 3 a side view of a gripper in a first refinement;

Figure 4 a schematic plan view of the feeder area of a printing press having a sheet transport system in accordance with the present invention;

Figure 5 a section through the feeder of Figure 4, along line V-V; and

Figure 6 a detail of the feeder of Figure 4, in a section along line VI-VI;

Figure 7 a side view of a gripper in accordance with a second variant.

In the print unit of a rotary sheet-fed printing press schematically depicted in Figure 1, cylinders 50, 51 represent a printing cylinder and a blanket cylinder, respectively, between which a sheet to be printed is guided. A sheet transport system 1 includes two guide rails 6a, 6b, disposed one behind the other, normal to the drawing plane, in which driving **[propulsive]** elements 10 constructed of individual chain links of magnetizable material are run, and drive stations 8 configured above and below guide rails 6a, 6b are driven. Drive stations 8 each include electromagnetic coils, which are selectively excited by a control circuit 30 to regulate the forward motion of individual driving elements 10 in each rail 6a, 6b.

Figure 2 is a detailed illustration of the sheet transport system. It corresponds to a partial section through the upper of the two cylinders 50 along line II-II in Figure 1 and, respectively, to a plan view of lower cylinder 51, including a sheet 2 guided over it.

Sheet transport system 1 includes two guide rails 6a, 6b, which extend in the figure to the right and left of cylinders 50, 51. Components in the two guide rails are differentiated in the following by the letters a and b, respectively, depending on whether they belong to the right or left rail.

Guided, respectively, in rail 6a and 6b, depicted in section, are driving elements 10a and 10b, which are made up[3] of a plurality of chain links 12a, 12b articulated by joints 24a, 24b that are rotatable about an axis normal to the drawing plane. The length of driving elements 10a, 10b is selected so that each driving element is always subject to the magnetic force of at least one of drive stations 8a, 8b, arranged at uniform distances on the rails. One of chain links 12a, 12b of each drive element supports a gripper 20a, 20b, which, through a longitudinal slot 7 (see Figure 5) of guide rail 6a and 6b, respectively, meshes with the interspace between the two rails. Grippers 20a, 20b hold sheet 2 in each case on a longitudinal edge near its front transverse edge, viewed in the feed direction. The width of sheet 2 is slightly greater than the active width of cylinders 50, 51, and grippers 20a, 20b hold sheet 2 on an area of the sheet that extends beyond the width of cylinders 50, 51, in the direction of guide rails 6a and 6b, respectively. This rules out any chance of grippers 20a, 20b coming in contact with the surfaces of cylinders 50, 51. In the event that an error occurs when the movements of drive elements 10a, 10b and of cylinders 50, 51 are electronically synchronized by control circuit 30, at most, this can result in the image to be printed by the cylinders on sheet 2 being incorrectly positioned, but not in any danger whatsoever of damage. No provision is made for a mechanical coupling of grippers 20a, 20b, as provided, for instance, by the cross bar known from the German 2 501 963. The synchronization of the motion of drive elements 10a, 10b required to evenly guide sheet 2 is achieved in that control circuit 30 drives each of the mutually opposing drive stations 8a and 8b, respectively, of the two rails in the same way. Here as well, the

[3] **Translator's note: Verb missing in the German text.**

need is eliminated for a mechanical forced coupling of the two grippers 20a, 20b, without this leading to a loss of operational reliability of the transport system, i.e., of a printing press equipped with the transport system. This is due to the fact that in the case of the transport system according to the present invention, any lack of synchronicity in the movement of two grippers holding a same sheet can lead to the sheet to be transported tearing, not, however, to a canting of the transport system and, thus, also not to mechanical damage to this or other parts of the printing press.

Figure 3 depicts a view of gripper 20b of Figure 2, viewed from the direction of arrow III in Figure 2. The gripper is designed as a type of clamp, having two jaws 21, 22, articulated at a joint 25 and, at their mutually facing inner sides, bearing retaining members 23, whose material contacts the material of the sheet with a high coefficient of friction. In the normal transport state of the gripper shown in the figure, a tension spring 26 keeps the two jaws 21, 22 pressed against one another. An arm 27 is used to secure the gripper in one of links 12a, 12b of drive element 10. Upper jaw 21 of the gripper that is able to swing via joint 25 toward arm 27 is at least partially made of a magnetic, preferably soft magnetic material, as are chain links 12a, 12b.

Figure 4 shows a plan view of a feeder region of the sheet transport system according to the present invention. The same feeder region is illustrated in section, in Figure 5, along line V-V of Figure 4. A sheet pile 40 is arranged at the pick-up edge of a feeding table **[feedboard]** 41 and kept at a level where top-most sheet 2 of the pile can be slid by a separating device (not shown) onto feeding table 41 into the position shown in Figures 4 and 5.

Guide rails 6a, 6b each form a closed circuit in which grippers 20a, 20b circulate in pairs, synchronously in the direction of arrows 42. The circuit includes an intake section 4a, 4b in the vicinity of the pick-up edge of feeding table 41, in which rails 6a, 6b run toward each other in the transport plane of sheet 2,

and contiguous thereto, a transport section, where they run in parallel. In intake section 4a, 4b, grippers 20a, 20b pass through underneath magnets 43a, 43b mounted above rails 6a, 6b, the magnets exerting a force of attraction on upper jaw 21 of each gripper, lifting it opposite the force of tension spring 26. Thus, when passing through underneath magnets 43a, 43b, the grippers are in an open position **[setting]**. In this position, they approach the sheet to be transported, from the side, to the point where side edges 3 of the sheet engage between jaws 21, 22. Typically, the depth of engagement can amount to 5 to 10 mm.

The separating device places sheet 2 with its front edge, viewed in the feed direction, disposed more or less at the level of the rear ends of magnets 43a, 43b. At this location, grippers 20a, 20b leave the field of magnets 43a, 43b, so that their jaws close, grasp side edges 3 of sheet 2, and transport sheet 2 away from the illustrated position.

Figure 4 depicts a pair of grippers 20a, 20b, at the moment when they close at the level of the front edge of sheet 2.

Two sensors 44a, 44b are flush-mounted transversely to the feed direction of sheet 2, spaced apart from one another in the surface of feeding table 41. These sensors detect the instant when they are crossed over by a sheet that is grasped by one of grippers 20a, 20b and being carried away from the position shown in Figure 4. This detection makes it possible for control circuit 30 to precisely determine the position of sheet 2 in relation to the printing press, independently of how the sheet had been grabbed by grippers 20a, 20b. This is useful, since the position of the sheet in relation to a gripper can fluctuate to a certain extent from one feed operation to the next. The control on the basis of the detection results of sensors 44a, 44b makes it possible, on the one hand, to compensate for any skewing of sheet 2, in that the two grippers 20a, 20b holding sheet 2 are driven in slight variation, and, on the other hand, to synchronize the position of the front edge of sheet 2 precisely with the motion of printing cylinders 50, 51.

To run a sheet through the printing press, it suffices, in principle, when the sheet is gripped at its front edge and pulled through the press. However, for a precise, balanced guidance of the sheet, it is desirable for it to be held at more than one location along its longitudinal edges. This can be easily done using the transport system according to the present invention, since the individual drive elements 10a, 10b are not coupled to one another and, in general, are able to be driven, independently of one another, by the individual drive stations 8a, 8b. Control circuit 30 can drive the drive stations in such a way that, in each case, two successive grippers circulate at such a distance along guide rails 6a, 6b that a first gripper receives a sheet to grasp near its front edge, and a following gripper grasps it at a location disposed further behind, preferably at the level of its rear edge. Applying a slightly greater driving force to the front gripper than to the gripper that follows enables the sheet to be conveyed through the printing press, stretched tightly **[taut]** under a substantially arbitrarily selectable initial tension.

The feeding table of Figure 4 has a central bearing surface 45 and in each case, between bearing surface 45 and guide rails 6a, 6b, deep-set channels 46a, 46b for receiving lower jaws 22 of grippers 20a, 20b during their feed motion. To prevent the side edges of one sheet having little inherent rigidity from hanging down into these channels 46a, 46b before they can be grasped by grippers 20a, 20b, it is useful to provide air vents 47 at the base of these channels, in particular below magnets 43a, 43b, to release a dosed air flow to hold the edges of sheet 2 at a level where they can be grasped by grippers 20a, 20b.

In a cross-section along line VI-VI of Figure 4, Figure 6 shows a preferred arrangement of air vents 47 on an enlarged scale. Here, air vent 47 extends diagonally below bearing surface 45 of feeding table 41, and is open at a side wall 48 of channel 46a. An air flow emerging from the air vent in the direction of arrow 49 lifts side edge 3 of sheet 2 out of the position shown with a solid line

into a position shown with a dotted line, where it essentially comes into alignment with the part of sheet 2 resting on bearing surface 45. At the same time, the air flow exerts a tensile force in the lateral direction, on side edge 3, stretching the sheet transversely to its feed direction. With this measure, even sheets 2 having little intrinsic rigidity are able to be securely grasped by grippers 20a, 20b, without the danger of side edge 3 colliding with lower jaw 22 of a gripper and buckling in the process.

Figure 7 depicts a second variant of a gripper. Parts which correspond to those of the gripper of Figure 3 bear the same reference numerals and are not described once more. In place of a tension spring, a pressure spring 28 is provided, which is arranged between arm 27 and an extension prolongation of upper jaw 21. A force 29 acting from above on the extension prolongation allows the gripper to open. A gripper of this kind can be used, for example, in a transport system having a feeder similar to that of Figures 4 and 5, magnets 43a, 43b being replaced by pressure profiles underneath which the extension prolongation slides along and which press down the extension prolongation, while the gripper moves from the side toward the side edges of a sheet to be grasped.

Provision is made in each case at the distributor of the sheet transport system at guide rails 6a, 6b for an outlet **[delivery end]** region, which is designed analogously to the intake region 4a, 4b. There, other magnets, i.e., pressure profiles are provided for opening the grippers and for releasing the printed sheet on a storage pile. The opened grippers 20a, 20b move away from one another on the rails 6a, 6b, which diverge in the outlet **[delivery end]** section, and are transported back to intake region 4a and 4b, respectively.

Patent Claims

1. A sheet transport system for a rotary **[printing]** press having rails (6a, 6b) configured on both sides of a sheet transport path, driven grippers (20a, 20b) being guided on these rails for pulling a sheet (2) to be conveyed in the feed direction,
characterized in that
the grippers (20a, 20b) engage with side edges (3) of the sheet (2) near its front end, viewed in the feed direction.

2. The sheet transport system as recited in Claim 1, characterized in that
the rails (6a, 6b) run along at least one gap **[nip]** between two cylinders (50, 51) of the rotary press.

3. The sheet transport system as recited in Claim 2, characterized in that
the rails (6a, 6b) run continuously between a feeder and a delivery device of the rotary press.

4. The sheet transport system as recited in one of the preceding claims,
characterized by
an electronic control circuit (30) for synchronizing the motion of the grippers (20a, 20b) with the rotation of the cylinders (50, 51).

5. The sheet transport system as recited in Claim 4, characterized in that the control circuit (30) synchronizes the motion of the grippers (20a, 20b) which are mounted on different rails (6a, 6b) and hold a same sheet (2).

6. The sheet transport system as recited in one of the preceding claims, characterized in that at least one pair of lagging grippers (20a, 20b) is run on the rails (6a, 6b) to grip a lagging end of a sheet (2).

7. A sheet transport system as recited in Claim 6, characterized in that the lagging gripper pair (20a, 20b) is braked.

8. The sheet transport system as recited in one of the preceding claims, characterized in that the grippers (20a, 20b) each include two clamping jaws (21, 22), and that, in each case, magnets (43a, 43b) are arranged at an intake area (4a, 4b) and/or at an outlet **[delivery end]** area of the rails (6a, 6b) for opening the clamping jaws (21, 22) by magnetic force.

9. The sheet transport system as recited in Claim 8, characterized in that the clamping jaws (21, 22) are squeezed together by a spring element (26).

10. The sheet transport system as recited in one of the preceding claims,
characterized in that
the rails (6a, 6b) diverge at their intake area (4a, 4b) and/or outlet **[delivery end]** area transversely to the feed direction, in the plane of the transported sheet (2).

11. The sheet transport system as recited in one of the preceding claims,
characterized in that
the grippers (20a, 20b) hold the sheet (2) in an area of the sheet (2) that extends beyond the width of the cylinders (50, 51) of the rotary press.

Abstract

A sheet transport system for a rotary press having rails (6a, 6b) configured on both sides of a sheet transport path, driven grippers (20a, 20b) gripping a sheet (2) to be transported near its front end, viewed in the feed direction, at its side edges and pulling it through the rotary press.